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# INSTRUCTION MANUAL

PRECISION POWER
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SERIES 400
PLUG-IN OSCILLATORS

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SERIES 400
PLUG-IN OSCILLATORS

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## WARRANTY

Elgar Corporation warrants each instrument it manufactures to be free from defects in material and workmanship. The corporation's obligation under this warranty is limited to servicing the instrument and replacing defective parts. This warranty is effective for one year after delivery of the instrument to the original purchaser. Defects caused by improper operating conditions, misuse, negligence, or the alteration or removal of the nameplate, will void the warranty. Elgar Corporation shall in no circumstance be liable for any direct or consequential loss or damage of any nature resulting from the malfunction of the instrument. This warranty is effective in lieu of any or all other obligations or liabilities on the part of Elgar Corporation, its agents, or representatives.

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# SECTION I
# INTRODUCTION AND GENERAL DESCRIPTION

## 1-1. INTRODUCTION

1-2. This manual describes the Series 400 plug-in oscillators manufactured by Elgar Corporation for use with the Elgar Power Sources. The manual contains installation, operation, maintenance instructions, circuit descriptions, circuit diagrams, and parts lists.

## 1-3. GENERAL DESCRIPTION

1-4. The Elgar oscillators are contained in a plug-in enclosure which can be inserted into the front panel opening of an Elgar Power Source. The plug-in enclosure contains a horizontally-mounted printed circuit board, and a terminal connector which mates with a similar connector in the power source. The 0.1% model is provided with a front panel access hole for a screwdriver frequency adjustment. The oscillators are available in 50, 60, 400, 800, 3200, and 4800 Hz output frequencies, or any frequency from 45 Hz to 10 KHz on special order.

## 1-5. PURPOSE OF EQUIPMENT

1-6. The Elgar Series 400 plug-in oscillators provide stable input frequency signals for the Elgar Power Sources. The plug-ins provide frequency accuracy of 0.1%, 0.01%, and 0.0001% (see Figure 1-1 for an explanation of model numbering). The 0.01% and 0.0001% oscillators use a crystal-controlled oscillator. In the 0.1% models, a square wave is generated by positive feedback around the filter to generate the basic frequency signal which is filtered in two series operational amplifier filters. Frequency adjustments may be made from the front panel.

1-7. In the 0.01% and 0.0001% models, the crystal oscillator output is divided through a series of integrated circuit flip-flops to obtain the desired output frequency. The output of the frequency divider flip-flops is filtered in two operational filters connected in series.

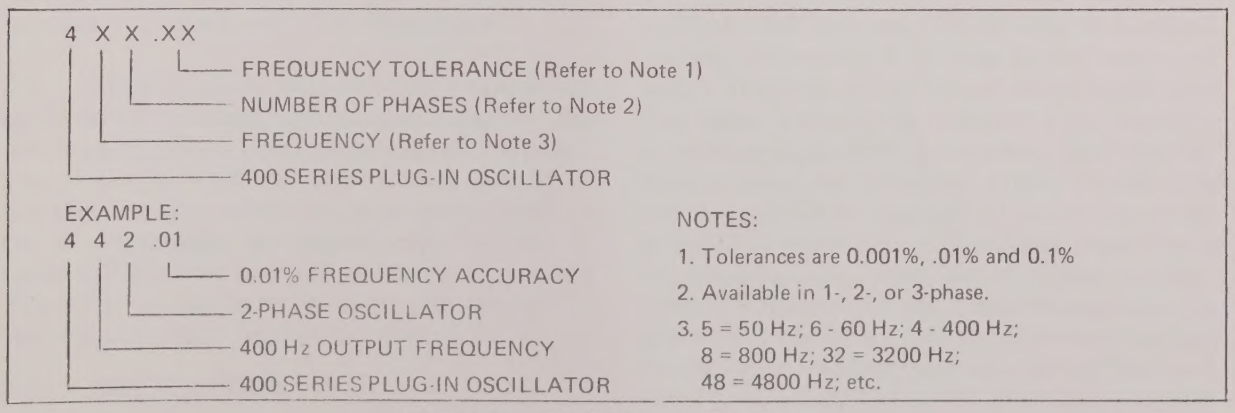

4 X X .XX
FREQUENCY TOLERANCE (Refer to Note 1)
NUMBER OF PHASES (Refer to Note 2)
FREQUENCY (Refer to Note 3)
400 SERIES PLUG-IN OSCILLATOR
EXAMPLE:
4 4 2 .01
0.01% FREQUENCY ACCURACY
2-PHASE OSCILLATOR
400 Hz OUTPUT FREQUENCY
400 SERIES PLUG-IN OSCILLATOR
NOTES:
1. Tolerances are 0.001%, .01% and 0.1%
2. Available in 1-, 2-, or 3-phase.
3. 5 = 50 Hz; 6 - 60 Hz; 4 - 400 Hz;
8 = 800 Hz; 32 = 3200 Hz;
48 = 4800 Hz; etc.

Figure 1-1. Model Numbering System

## 1-8. RESISTANCE PROGRAMMING

1-9. When an Elgar Plug-In Oscillator has been equipped for resistance programming of the output voltage of the AC Power Source the model number will indicate so by including a "P" at the end of the number.

1-10. Resistance programming is accomplished by connecting an external resistor between pins 11 and 12 of Connector J1, located on the rear panel of the AC Power Source. The value of the resistor is typically at 100 ohms per volt, referenced to the output of the AC Power Source on the 0.0 to 130V range.

1-11. The external resistor is in fact taking the place of the feedback resistor in the operational amplifier circuit of the oscillator. It is important to know that during initial calibration this resistor must be matched to the input resistor of the operational amplifier to obtain a gain of 1. Once this is accomplished the front panel amplitude control may be rotated to the desired full scale output voltage on the AC Voltage Meter located on the front panel of the Power Source. The reading is typically 130V and in effect provides the 500 ohms per volt calibration.

## 1-12. TANDEM OPERATION

1-13. For all single phase Series 400 Plug-In Oscillator whose model number ends in a T (4X1.XXT) R115, a 475 ohm, 1% resistor and a jumper between pins 9 and 21 have been added for tandem operation.

1-14. For all two or three phase oscillators whose model number ends in a T (4X3.XXT) a jumper has been added between pins 9 and 21 for tandem operation. (Note: R115 is already present.

1-15. The addition of the jumper between pins 9 and 21 enables the master AØ signal to also be routed to the slave unit allowing the system to be operated in the tandem configuration.

# SECTION II
# INSTALLATION AND OPERATION

## 2-1. INTRODUCTION

2-2. The Elgar plug-in oscillators are aligned, calibrated, and tested prior to shipment. The instrument is therefore ready for immediate use upon receipt. The following checks should be made however, to assure that the instrument has suffered no damage during shipment.

## 2-3. UNPACKING THE INSTRUMENT

2-4. Make a visual inspection of the shipping container prior to accepting the package from the carrier. If extensive damage to the shipping container is evident, a description of the damage should be noted on the carrier's receipt, and signed by the driver or carrier agent. If damage is not apparent until the instrument is unpacked, a claim for concealed damage should be placed with the carrier and all shipping containers and filler material saved for inspection. Forward a report of damage to the Elgar Service Department, which will provide instructions for repair or replacement of the instrument.

2-5. Visually inspect instrument for physical damage when it is removed from shipping container. Test functional operation of instrument as soon as possible. If damage is evident, or instrument does not function properly, notify the carrier immediately. Carrier's claim agent will prepare a report of damage to be forwarded to the Elgar Service department. You will be advised as to the action necessary to have the instrument repaired or replaced.

## 2-6. INSTALLATION

2-7. The oscillator is quickly and easily installed by plugging it into the space provided on the front panel of the Elgar Power Source. When the oscillator is fully inserted, and the captive screws secured, the unit is ready for operation.

**NOTE**

Remove power from Power Source when installing oscillator.

## 2-8. OPERATION

2-9. After installation in the Elgar Power Source, the oscillator operates automatically, receiving its power from the power source. The amplitude of the power source output is controlled by the AMPLITUDE control on the front panel of the power source.

## 2-10. OPERATION WITH EXTERNAL SYNC

2-11. The .1% oscillators with model numbers ending in "ES" are equipped for external synchronization. The external sync signal should be approximately 10V peak-to-peak either sine or square wave. This signal is transformer isolated in the oscillator to avoid cross-grounding problems. The external sync terminals are connected to pins 11 and 12 of the Jones S312AB receptacle, J1, on the rear panel of the Elgar Power Source. The phase angle between the power source output and the synchronizing signal is a function of the synchronizing signal amplitude and waveshape and the difference between the oscillator free-running frequency and the sync signal frequency. Figure 2-1 illustrates a typical plug-in Oscillator/AC Power Source Interconnection.

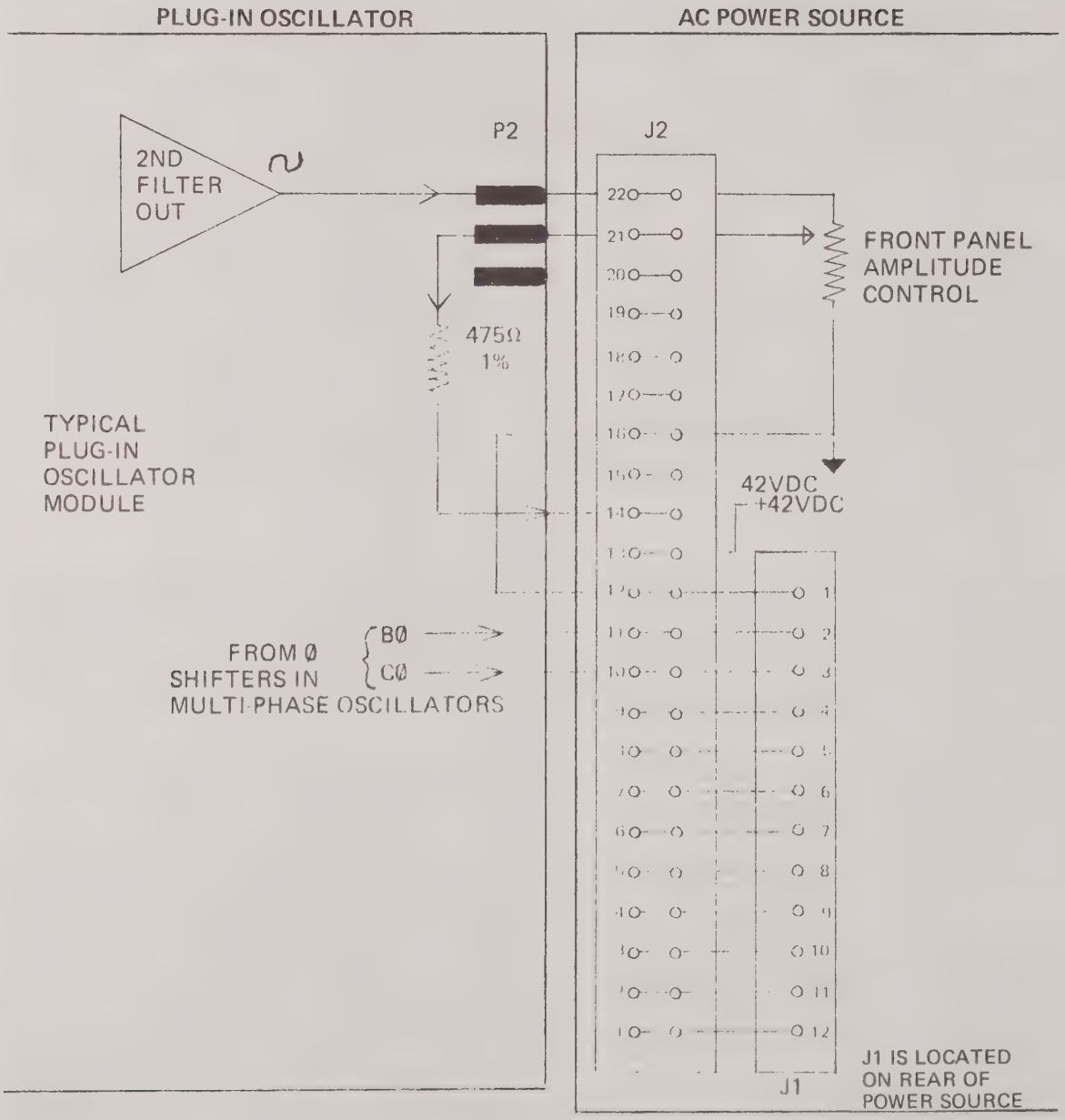



Figure 2-2. Typical Plug-in Oscillator/Power Source Interconnection

## 2-12. INTERCONNECTIONS FOR TWO OR THREE PHASE OPERATION

2-13. Three-phase oscillators may be installed directly in Elgar three-phase power sources without special connections. Where two-phase or three-phase power is made up by stacking two or three of the Elgar single-phase power sources, the oscillator is installed in the A-phase power source. Oscillator signals are carried to the B-phase and C-phase power sources through a cable (furnished with the oscillator) interconnecting the Jones S312AB sockets on the rear panels of the power source. The B-phase and C-phase power sources must have Model 400-B and 400-C signal routing plug-ins installed to complete the signal interconnections. The front panel AMPLITUDE control on the A-phase power source acts as a master control to vary all the outputs simultaneously, while the B-phase and C-phase AMPLITUDE controls act merely as balance controls to set the B-phase and C-phase output voltages equal to the A-phase output voltage.

2-14. With those single-phase Elgar Power Sources which have dual output windings, two power sources may be interconnected for three-phase wye operation. One of the output windings on each of the A-phase and B-phase sources is used for the A-phase and B-phase outputs. The C-phase output is synthesized by inverse series connection of the remaining two windings, as diagrammed in Figure 2-2.

## 2-15. EXTERNAL SIGNAL

2-16. Single-phase 0.1% and 0.01% oscillators are equipped with a front-panel closed-circuit jack for external signal operation. A 2-3 VRMS external signal may be introduced by plugging a Switchcraft No. 750 plug into the jack. The closed-circuit jack automatically disconnects the internal signal. The front panel Amplitude control is effective with the external signal connection.

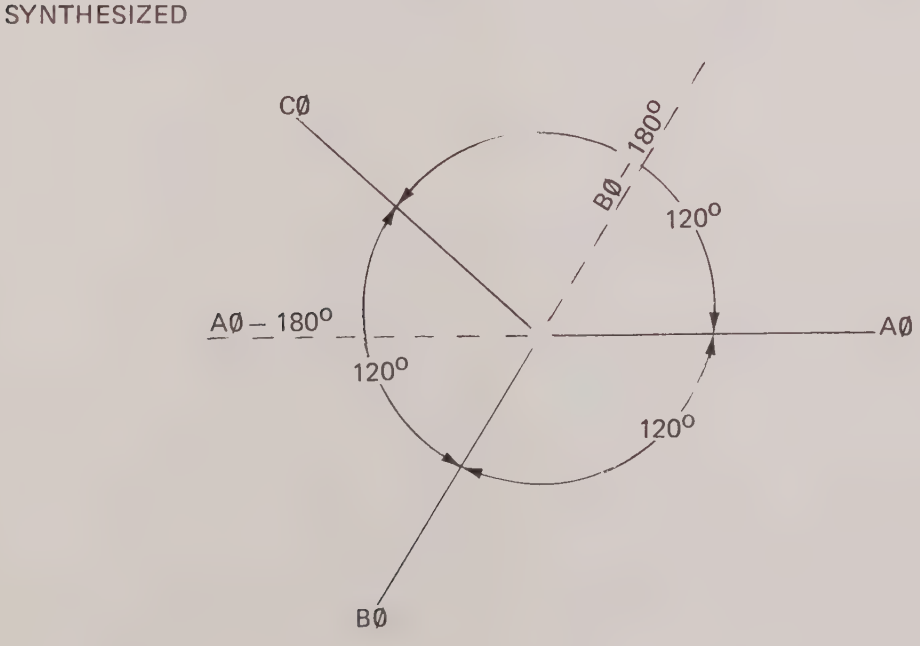



Figure 2-2. 2 Amplifier 3Ø Wye Configuration

# SECTION III
# THEORY OF OPERATION

## 3-1. INTRODUCTION

3-2. The Elgar Series 400 plug-in oscillators all use similar low voltage supplies and operational amplifier filters, and obtain operating power from the Elgar AC Power Source. The amplitude of the output signal for all units is controlled by an amplitude control potentiometer located on the front panel of the AC Power Source. The .1% models use a positive feedback square wave input to the operational amplifier filters. The .01% and .0001% oscillators contain a crystal-controlled oscillator and a frequency-dividing circuit formed by $T^2L$ integrated circuits. The output of the integrated circuits is a symmetrical square wave free from even harmonics.

## 3-3. .01% AND .0001% OSCILLATOR CIRCUIT DESCRIPTION

3-4. The .01% oscillators generate the output frequency by means of a crystal-controlled oscillator formed by Q111 and Q112. In .0001% oscillators this circuit is replaced with an oven-controlled oscillator module. Both oscillators operate at a frequency of 153.6 KHz. The square wave at the collector of Q112 or at the output of the oscillator module is then counted down to the operating frequency by integrated circuit counters Z106, Z107 and Z108. The square wave at the output of the counters is then used to drive Q113, operating as a saturated switch. T.C. zener diode CR103, connected from collector to emitter of Q113, limits the positive half cycle of the square wave to approximately +6.2V. The symmetrical square wave at the collector of Q113 is then taken to the input of the first active filter consisting of operational amplifier Z101 and filter-tuning components R122, R123, R124, C103 and C104. The output of Z101 is then taken to the input of the second active filter consisting of Z102 and tuning components R127, R128, R129, C105 and C106. Action of this two-section active low-pass filter is to remove harmonics from the square wave and thereby produce a pure sine wave at the output of Z102 whose amplitude is approximately 3 VRMS. The active filters are tuned for a peak response at the operating frequency and have a total of $180^o$ phase shift. Refer to the table at the bottom of Figure 5-4 for filter tuning values. Table 3-1 details Z106—Z108 for various output frequencies.

## 3-5. .1% OSCILLATOR CIRCUIT DESCRIPTION

3-6. .1% oscillators also operate by generating a square wave and then filtering it in a two-section active low-pass filter. However, in these oscillators the square wave is generated by positive feedback around the filter through a voltage comparator. Referring to Figure 5-2, the output of the second filter drives the voltage comparator Z106 through R116. The square wave at the output of Z106 is limited to +6.2V by T.C. zener diode CR103. The square wave is then coupled to the two-section active filter whose operation is as explained in Paragraph 3-4 above. R130 in the second active filter is used to adjust the frequency over a small number of cycles around the nominal output frequency. Initial frequency tuning is accomplished by factory-selected trim capacitors in the two active filters.

## 3-7. TWO-PHASE AND THREE-PHASE OSCILLATORS

3-8. In two-phase and three-phase oscillators, the oscillator signal from the AMPLITUDE control arm in the A-phase power amplifier is buffered by unity gain amplifier Z105 and applied to two operational amplifier all-pass phase shifters, Z103 and Z104. A block diagram of circuitry used to generate two- and three-phase signals is provided in Figure 3-1. In three-phase oscillators, the B-phase signal lags the A-phase signal by $120^{o}$ and the C-phase signal lags the B-phase signal by $120^{o}$. In two-phase oscillators the B-phase signal lags the A-phase signal by $90^{o}$ and the C-phase components are omitted. The B-phase and C-phase signals are connected through plug-in connector P2 to the 12-pin Jones S312AB receptacle, J1, on the rear of the A-phase power source. Interconnecting cables then carry these signals to the B-phase and C-phase power sources in stacked-amplifier systems (See Figure 3-2).

3-9. The A-phase AMPLITUDE controls acts as a master control to control the amplitude of all three phases simultaneously. When single-phase power amplifiers are stacked for two- or three-phase power, the B-phase and C-phase amplitude controls are used only as balance adjustments to set the B-phase and C-phase outputs equal to the A-phase output.

## 3-10. OSCILLATOR POWER SUPPLIES

3-11. The oscillator circuitry is operated from plus and minus 15 VDC regulated power supplies which are derived from the unregulated plus and minus 42 VDC power supplies in the associated power source. In the plus 15V power supply, differential pair Q103 and Q104 compare the plus 15V regulated output to the reference voltage from CR102, developing an error signal to control com-

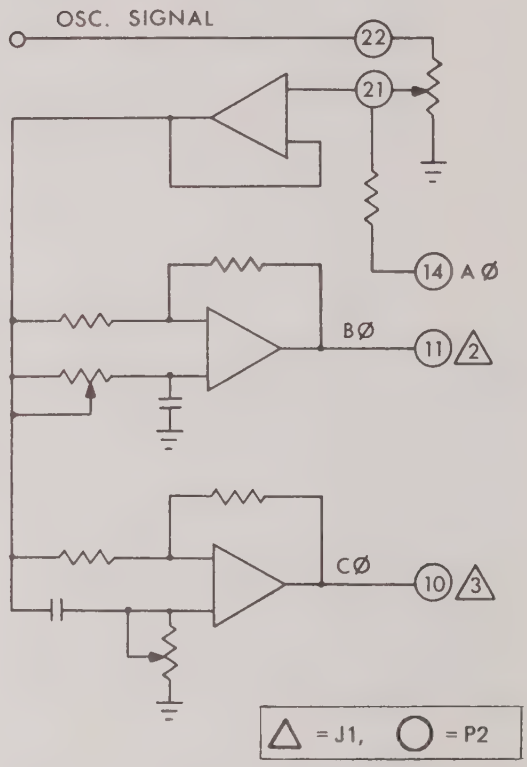
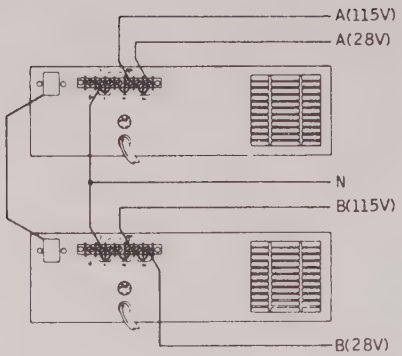



Figure 3-1. Two- and Three-Phase Circuit Block Diagram

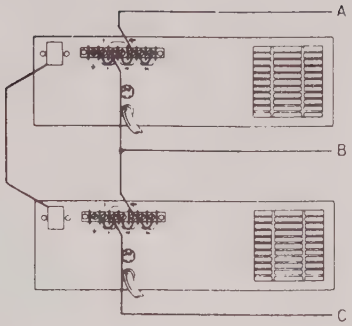
Table 3-1. Output Frequency, I.C. Selection

| FREQUENCY | 10 | 11 | 12 |
|---|---|---|---|
| 10 KHz | MC7490P | | |
| 9.6 KHz | MC7493P | | |
| 4.8 KHz | MC7493P | | MC7493P |
| 3.2 KHz | MC7492P | | MC7493P |
| 1.2 KHz | MC7493P | | MC7493P |
| 800 Hz | MC7492P | | MC7493P |
| 400 Hz | MC7492P | MC7493P | MC7493P |
| 60 Hz | MC7490P | MC7493P | MC7493P |
| 50 Hz | MC7492P | MC7493P | MC7493P |

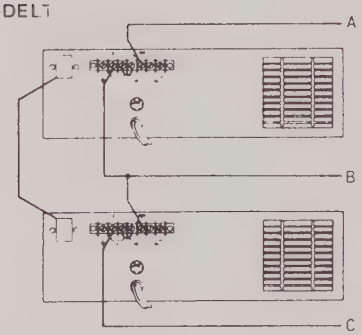
2-PHASE



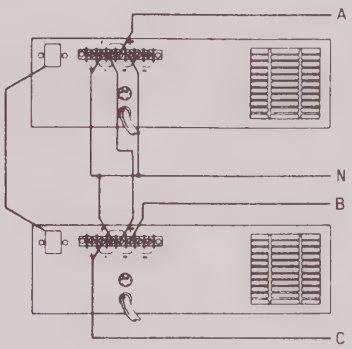

3-PHASE OPEN-DELTA (115V)



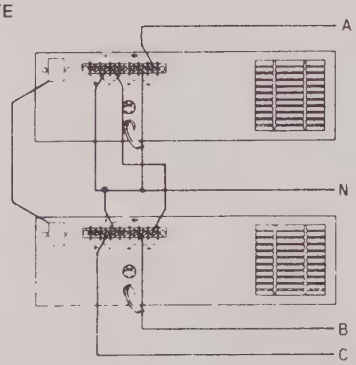

3-PHASE OPEN-DELTA (208V)



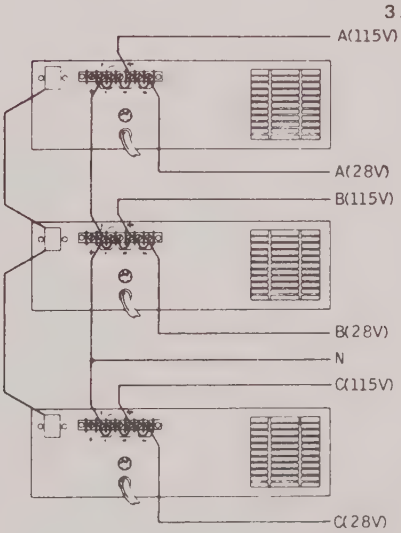

2 AMPLIFIER WYE (115V)




2 AMPLIFIER WYE (28V)




3 AMPLIFIER WYE




3-PHASE OPEN-DELTA (28V)

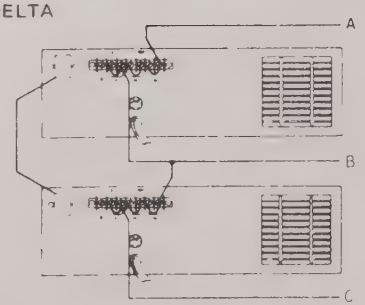



Figure 3-2. Rear Panel Connections for Two- or Three-Phase Operation

pound-connected pass transistors Q101 and Q102. R102, R103, and CR101 ensure that the regulator starts when power is applied. R101 limits the fault current if the +15V output is accidentally shorted.

3-12. In the minus 15V regulator, differential pair Q107 and Q108 develop the error signal by comparing the −15V regulated output to the regulated +15V. The error signal is used to control compound-connected pass transistors Q106 and Q107. R109 limits the fault current if the −15V output is accidentally shorted.

# SECTION IV
# MAINTENANCE

## 4-1. SERVICE INFORMATION

4-2. Questions concerned with the operation, repair, or servicing of this instrument should be directed to the nearest Elgar representative or to the Service Department, Elgar Corporation, 8225 Mercury Court, San Diego, California 92111. Include the model number and serial number in any correspondence concerning the instrument.

## 4-3. FACTORY REPAIR

4-4. Should it be necessary to return an instrument to the factory for repair, please contact the Elgar Corporation Service Department for authorization to make shipment. DO NOT RETURN THE UNIT FOR REPAIR WITHOUT AUTHORIZATION.

## 4-5. SHIPPING DAMAGE

4-6. It is possible for equipment to be damaged in shipment. Therefore, it is imperative that the instrument be tested and inspected as soon as it is received. If the instrument shows signs of damage, notify the carrier immediately. The carrier's claim agent will prepare a report of damage to be forwarded to the Elgar Service Department. You will be advised as to the action necessary to have the instrument repaired or replaced.

## 4-7. TEST POINTS

4-8. Test points on the plug-in oscillator are shown in Figure 5-1 and Figure 5-3. These test points are accessible by removing the top cover of the power source.

4-9. The outputs of the various test points are as follows:

| | |
|---|---|
| Square Wave | ≈ .6V p-p |
| First Filter | ≈ 10V p-p |
| Second Filter | ≈ 10V p-p |
| B-Phase | ≈ 10V p-p sine wave |
| C-Phase | ≈ 10V p-p sine wave |

## 4-10. TROUBLESHOOTING

4-11. Whenever trouble is suspected in the plug-in unit, substitution of a unit known to be good will provide a quick check. If it is determined that trouble does exist in the plug-in unit, the first step is a check of the +15 VDC and −15 VDC. If the output is greatly reduced, check the oscillator operation at the collector of Q113. If a square wave of the proper frequency and amplitude is present, the trouble may be in the filter. Check the output of the first filter section at Q106.

NOTE

If a crystal-controlled oscillator is not working, check the crystal. Dropping the unit, or other rough handling may fracture the crystal.

4-12. Troubleshooting is accomplished by signal tracing at the test points shown in Figure 5-1 and Figure 5-3. For the crystal-controlled models, test for a signal at the crystal oscillator, the flip-flop dividers, a square wave at CR103 and a sine wave

at the two filter outputs, and at the B- and C-phase outputs.

4-13. If no output is present on the 0.1% model, inject a 3 VRMS signal at appropriate frequency through a 3.3K resistor into pin 3 of Z103. Check for 6.2V peak-to-peak signal at CR103 and for correct signals at the filter and B- and C-phase outputs.

4-14. The output frequency of the 0.0001% oscillator is adjustable by a screwdriver adjustment at the top of the oscillator module. Access is gained to this adjustment by removing the top cover of the power source. Allow a 30-minute warmup period. Do not change frequency setting unless a frequency standard of adequate accuracy is available for comparison.

4-15. PHASE-ANGLE ADJUSTMENT

4-16. The phase-angle adjustments are set at the factory and should not be disturbed unless appropriate test equipment is available to determine the output phase angles. If an accurate phase-angle meter is not available, phase angles may be determined by line-to-line voltage measurements. The front-panel voltmeters in the Elgar power sources are only accurate to ±3% and are not suitable for precision phase-angle adjustment.

4-17. Open Delta Connection: Set the two amplifier outputs $E_{CA}$ and $E_{CB}$ to 120V. Adjust B-phase, R136, until the open-leg voltage, $E_{AB}$ is 120V. The C-phase adjustment, R133, has no effect.

4-18. 2-Amplifier Wye Connection: Set the two amplifier outputs, $E_{NA}$ and $E_{NB}$ to 120V. Adjust B-phase, R136, until the line-to-line voltage $E_{AB}$ equals 207.84 volts. The C-phase adjustment, R133, has no effect.

4-19. 3-Amplifier Wye Connection: Set the amplifier outputs, $E_{NA}$, $E_{NB}$, and $E_{NC}$ to 120V. Adjust B-phase, R136, for line-to-line voltage equal to 207.84 volts. Adjust C-phase, R133, for line-to-line voltage $E_{AC}$ equal to 207.84 volts.

4-20. 2-Phase Connection: Set both amplifier outputs to 120V. Adjust B-phase, R136, until line-to-line voltage $E_{AB}$ equals 169.71 volts.

# SECTION V
# DIAGRAMS

## 5-1. GENERAL

5-2. This section contains the schematic diagrams and parts layout for the Series 400 Plug-in Oscillators. The schematic diagrams should be used to understand the theory of operation and as an aid in trouble-shooting the unit. Reference designators shown on schematics correspond to reference designators shown in parts lists where exact component values are given.

## 5-3. DIAGRAMS

5-4. Diagrams included in this section are as follows:

a. Component Layout for 0.1% Oscillators.

b. Schematic Diagram for 0.1% Oscillators.

c. Component Layout for 0.01% Oscillators.

d. Schematic Diagram for 0.01% Oscillators.

5-6 The schematics included in this section use ◯ to indicate P2 and △ to indicate pins related to Connector J1. J1 is located on the rear panel of the AC Power Source and P2 is the pins of the oscillator board which plug into Receptacle Connector J2 of the AC Power Source.

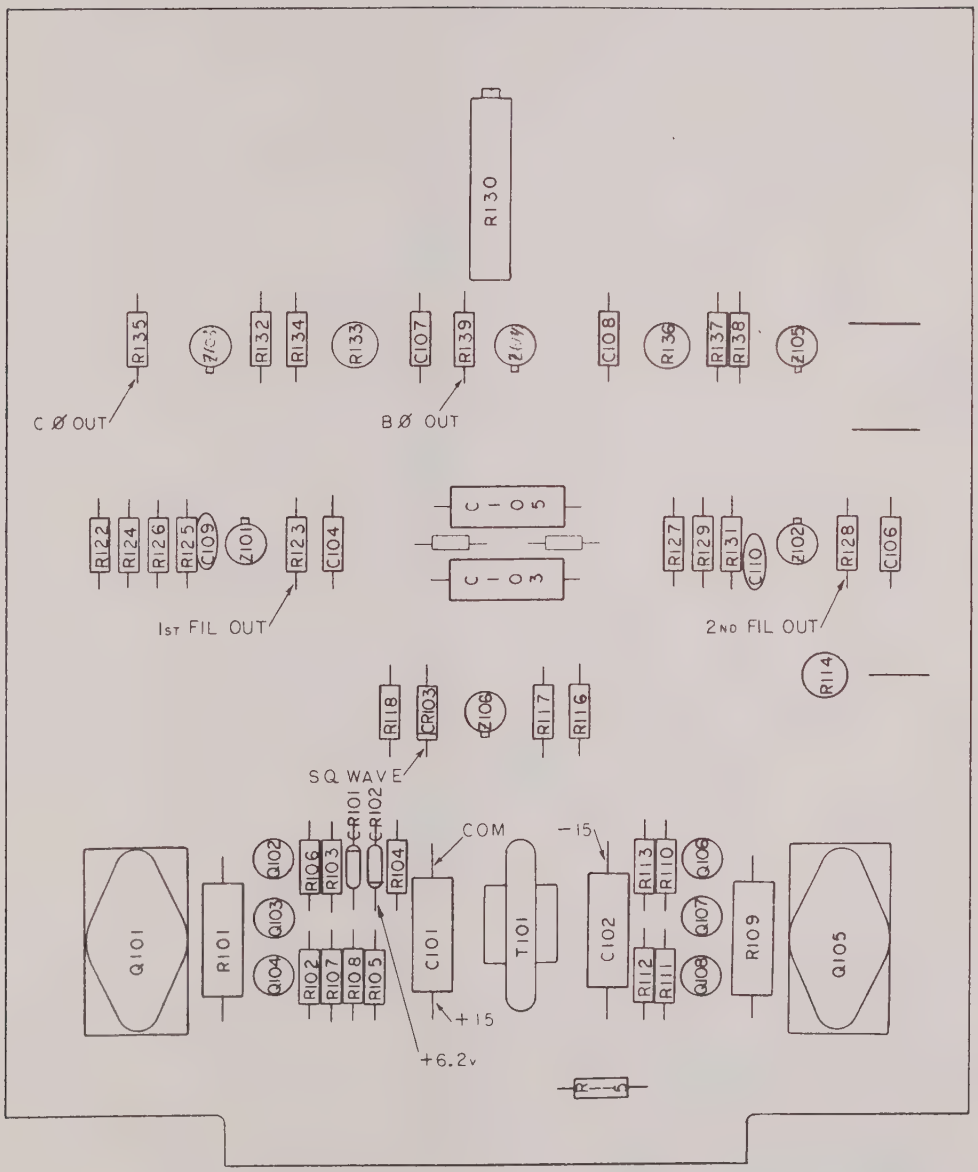
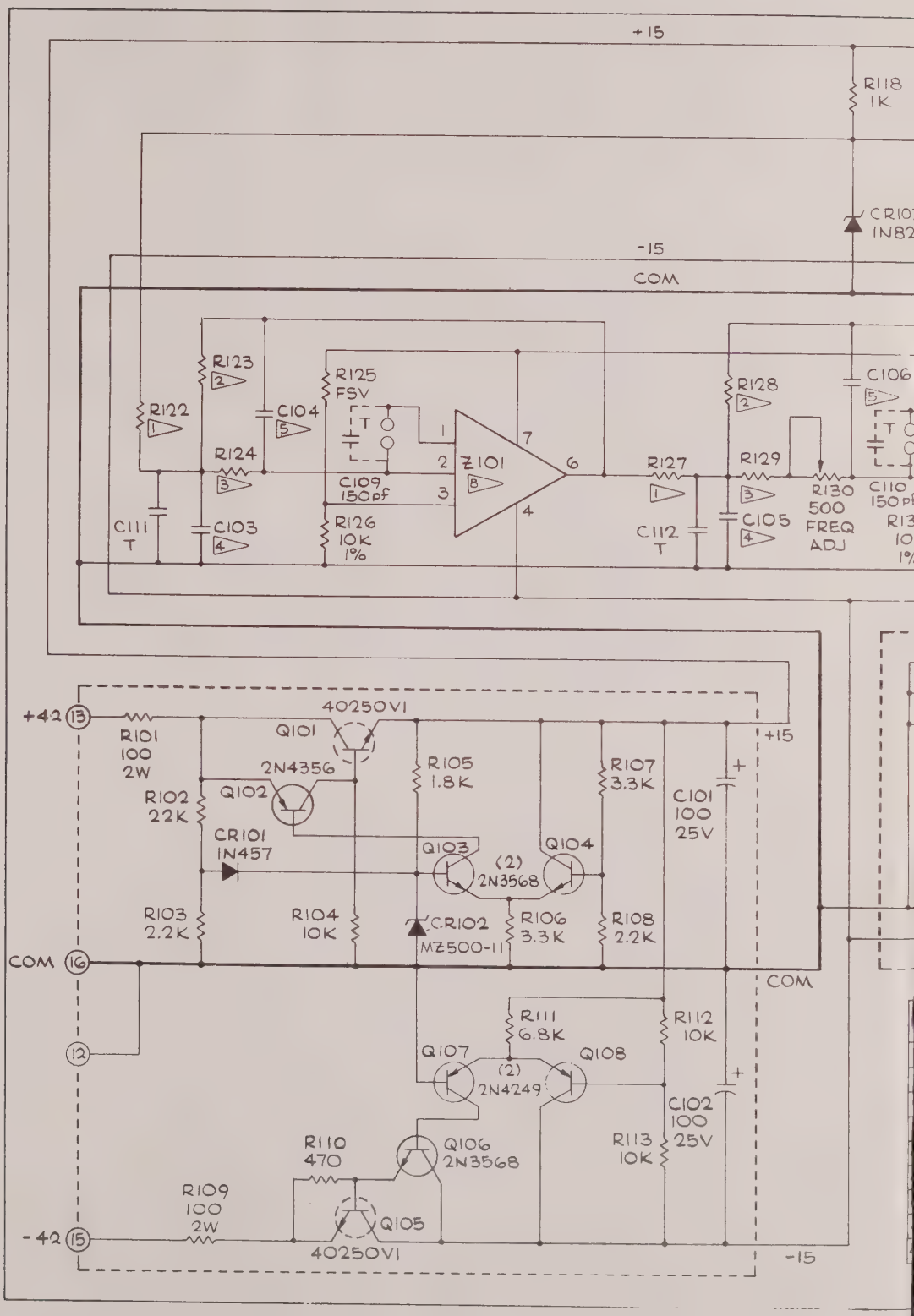
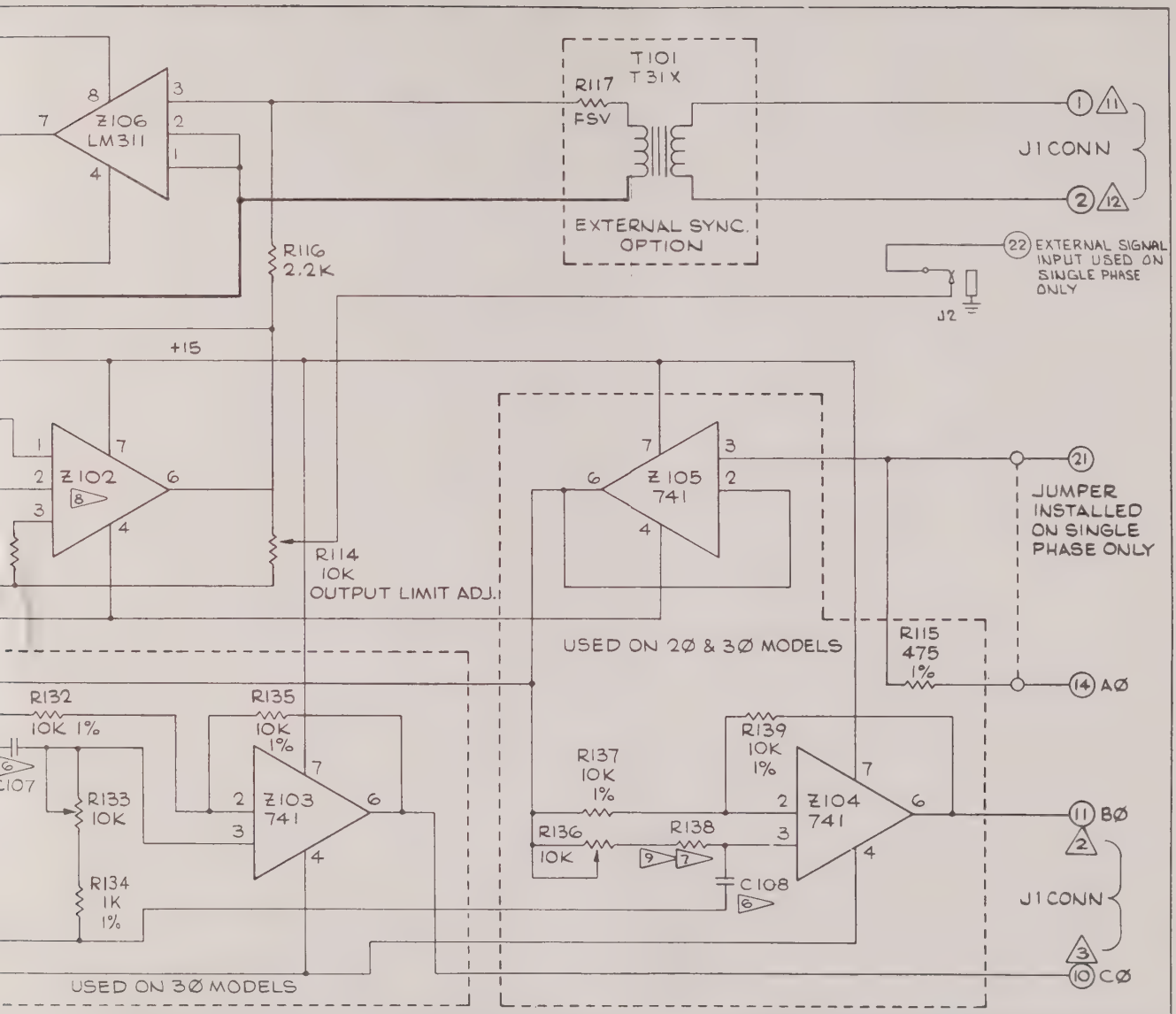



Figure 5-1. Component Layout for 0.1% Oscillators


+15
R118
1K
CR10
IN82
-15
COM
R123
R122
C104
R125
FSV
T
R124
C109
150pf
C111
T
C103
R126
10K
1%
Z101
R128
C106
R127
R129
R130
500
FREQ
ADJ
C110
150pf
C112
T
C105
+42
R101
100
2W
40250VI
Q101
2N4356
Q102
R102
22K
CR101
IN457
R105
1.8K
R107
3.3K
C101
100
25V
Q103
Q104
(2)
2N3568
R103
2.2K
R104
10K
CR102
MZ500-11
R106
3.3K
R108
2.2K
COM
R111
6.8K
R112
10K
Q107
Q108
(2)
2N4249
C102
100
25V
R110
470
Q106
2N3568
R113
10K
R109
100
2W
Q105
-42
40250VI




| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| ODEL | FREQ | R122 R127 | R123 R128 | R124 R129 | C103 C105 | C104 C106 | C107 C108 | R138 | Z101 Z102 |
| -53-.1 | 50 | 14.7 K | 8.06K | 7.50K | 2 µF | .082 µF | .33 µF | 11.5 K | 741 |
| -63-.1 | 60 | 9.76 K | 17.4K | 4.32K | 2 µF | .082 µF | .33 µF | 8.06K | 741 |
| -43-.1 | 400 | 14.3 K | 7.15K | 4.75K | .33 µF | .012 µF | .047 µF | 8.06K | 741 |
| -83-.1 | 800 | 15 K | 7.87K | 5.11K | .15 µF | .0068 µF | .022 µF | 11.5K | 741 |
| -203-.1 | 1200 | 15.8 K | 5.36K | 4.75K | .1 µF | .004 µF | .015 µF | 8.06K | 741 |
| -323-.1 | 3200 | 6.04 K | 3.01 K | 2.00K | .1 µF | .0039 µF | .0047 µF | 11.5 K | LM301 |
| -803-.1 | 4800 | 4.02 K | 2.00K | 1.33K | .1 µF | .0039 µF | .0047 µF | 8.06K | LM301 |
| -1001-.1 | 10 KHz | 23.2K | 11.5 K | 7.68K | .0082 µF | 330 Pf | .001 µF | 11.5K | LM301 |
| -381-.1 | 380 | 11K | 5.62K | 7.87K | .33 µF | .012 µF | | | |

NOTES – UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE 1/2 W, 5% CARBON.
2. ALL RESISTANCE VALUES ARE IN OHMS(Ω).
3. ALL CAPACITANCE VALUES ARE IN µF.
9. R138 IS 4.75K ON ALL 2Ø MODELS.
10. ○ DENOTES P2 CONNECTIONS.

| REV | DESCRIPTION | DATE | DRAFT | APPR |
|---|---|---|---|---|
| 61 | ADDED JACK AT PN22 | 3-16-76 | | |

ELGAR CORPORATION
TITLE: 400 SERIES .1% 1, 2 & 3Ø OSC
DRAFT: HILLARD 5/28/71
FINISH: NONE
TYPE: SCHEM
SHT 1 OF 1
754-039 61

Figure 5-2. Schematic Diagram for 0.1% Oscillators

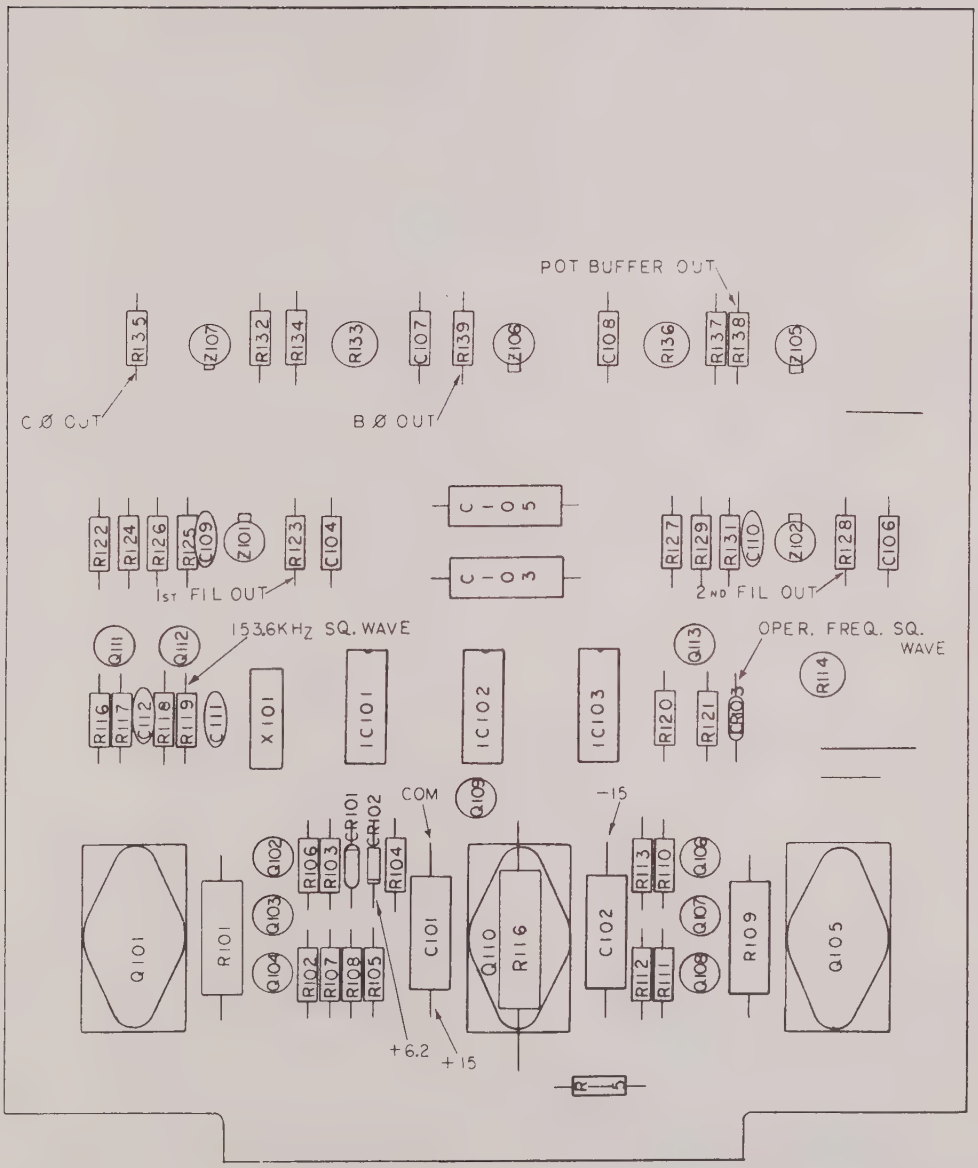
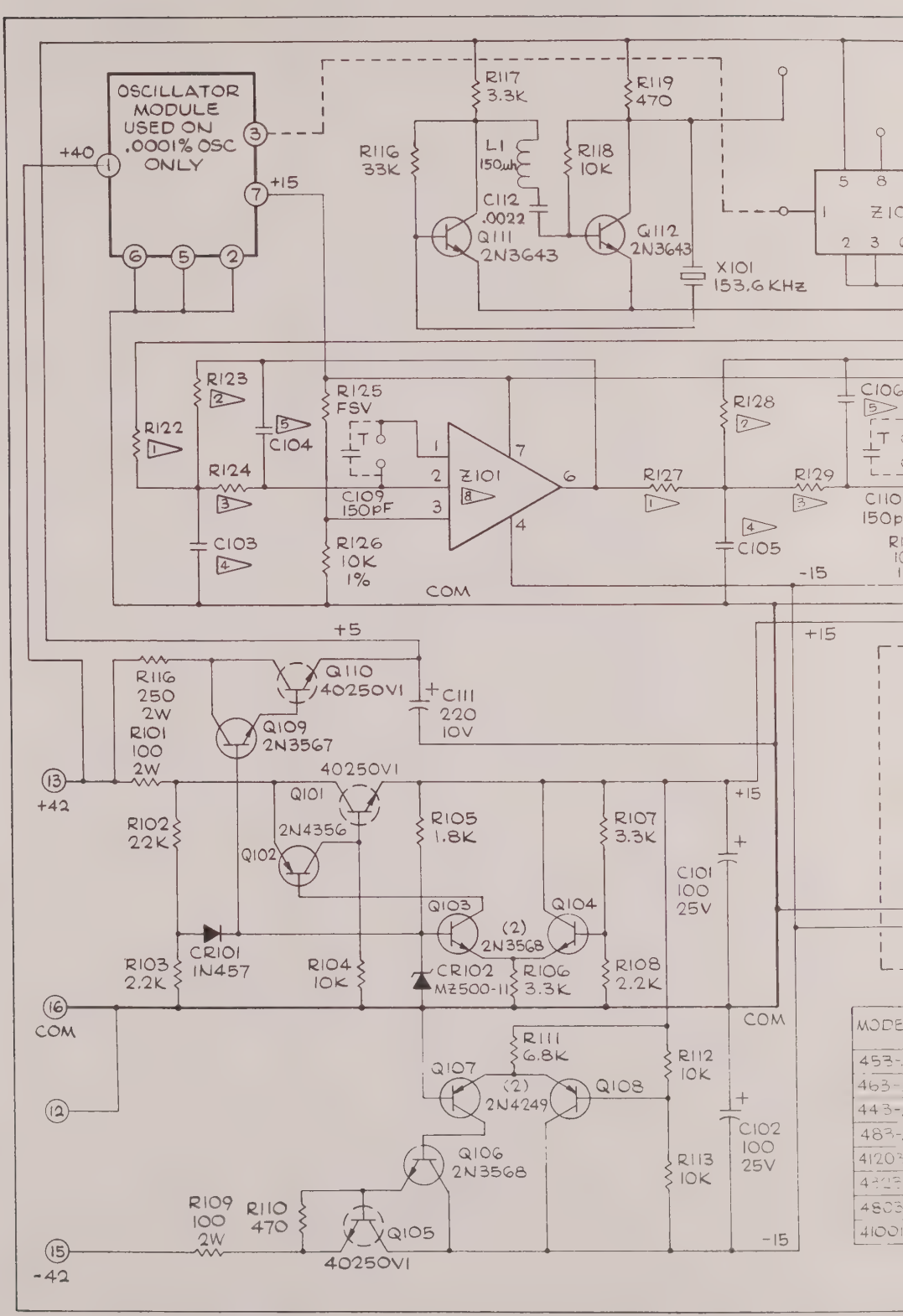
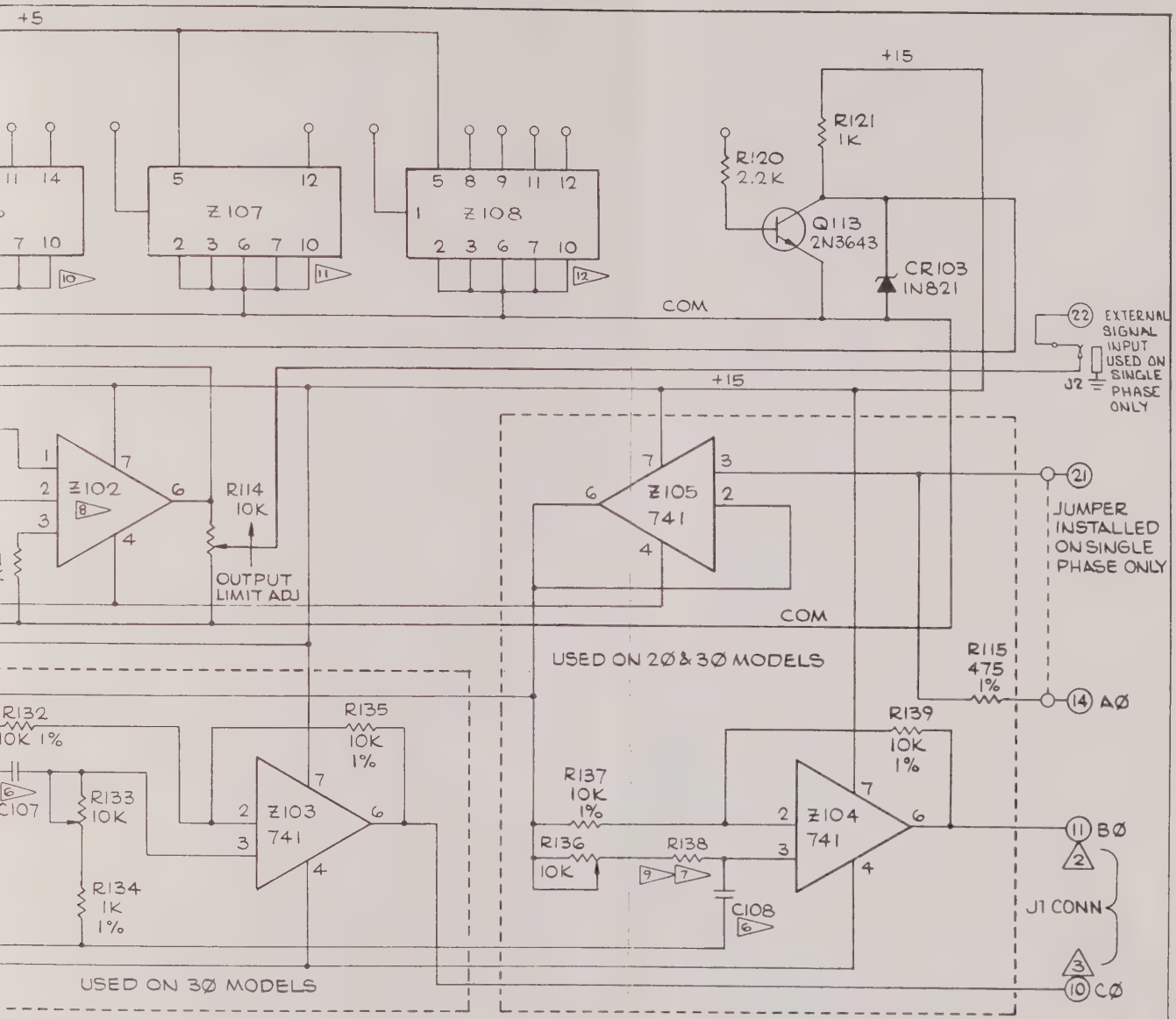



Figure 5-3. Component Layout for 0.01% Oscillators


OSCILLATOR MODULE USED ON .0001% OSC ONLY
+40
+15
R117 3.3K
R119 470
R116 33K
L1 150mh
R118 10K
C112 .0022
Q111 2N3643
Q112 2N3643
X101 153.6 KHz
R123
R122
C104
R125 FSV
R124
C109 150pF
C103
R126 10K 1%
Z101
COM
R128
R127
R129
C105
-15
+5
+15
R116 250 2W
R101 100 2W
Q110 40250V1
Q109 2N3567
C111 220 10V
+42
Q101 2N4356
Q102
R102 22K
R105 1.8K
R107 3.3K
C101 100 25V
Q103
Q104
(2) 2N3568
CR101 1N457
R103 2.2K
R104 10K
CR102 MZ500-11
R106 3.3K
R108 2.2K
COM
R111 6.8K
Q107
(2) 2N4249
Q108
R112 10K
C102 100 25V
Q106 2N3568
R113 10K
R109 100 2W
R110 470
Q105 40250V1
-42
-15




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| FREQ | R122 R127 | R123 R128 | R124 R129 | C103 C105 | C104 C106 | C107 C108 | R138 | Z101 Z102 |
| 50 | 14.7K | 8.06K | 7.5 K | 2 uF | .082uF | .33uF | 11.5 K | 741 |
| 60 | 17.4K | 9.76K | 4.32K | 2 uF | .082uF | .33uF | 8.06K | 741 |
| 400 | 14.3K | 7.15K | 4.75K | .33uF | .012uF | .047uF | 8.06K | 741 |
| 800 | 15 K | 7.87K | 5.11K | .15uF | .0068uF | .022uF | 11.5 K | 741 |
| 1200 | 15.8K | 5.36K | 4.75K | .1uF | .004uF | .015uF | 8.06K | 741 |
| 3200 | 6.04K | 3.01K | 2.00K | .1uF | .0039uF | .0047uF | 11.5 K | LM301 |
| 4800 | 4.02K | 2.00K | 1.33K | .1uF | .0039uF | .0047uF | 8.06K | LM301 |
| 10KHz | 23.2K | 11.5K | 7.68K | .0082uF | 330pF | .001uF | 11.5 K | LM301 |

NOTES – UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE ½W, 5% CARBON.
2. ALL RESISTANCE VALUES ARE IN OHMS (Ω).
3. ALL CAPACITANCE VALUES ARE IN uF.
9 R138 IS 4.75K ON ALL 2Ø MODELS.
10 11 12 REFER TO PARTS LIST.
13. ○ DENOTES P2 CONNECTIONS.

6 ECN #296 5/12/76 DJ
ELGAR CORPORATION
400 SERIES .01 & .0001 OSC
HILLARD 6/14/71
10/3/71
SCALE NONE
SCHEM
SHT 1 OF 1 604-042 B2
G2 ADDED JACK AT PN2 DR 3-16-76

Figure 5-4. Schematic Diagram for 0.01 and 0.0001% Oscillators

# SECTION VI
# REPAIR PARTS LIST

## 6-1. GENERAL

6-2. This section contains a listing of all parts necessary for factory authorized repair of the unit. Parts are located on the diagrams in Section V and correlated on the parts list by using their reference designators. Also included in this section is Table 6-1 which the resistor and capacitor values to be used for frequencies between 50 Hz and 10 KHz are listed.

## 6-3. SPARE PARTS ORDERING

6-4. When ordering spare parts, specify part name, part number, manufacturer, component value and rating. If complete assemblies are desired, contact:

ELGAR CORPORATION
8225 Mercury Court, San Diego, Calif. 92111

Specify assembly number, instrument series number and instrument name when ordering.

| SCHEMATIC DESIGNATION | VALUE | DESCRIPTION OR TYPE | RATING | MANUFACTURER | | ELGAR PART NUMBER |
|---|---|---|---|---|---|---|
| | | | | NAME | PART NUMBER | |
| PARTS COMMON TO ALL SERIES 400 PLUG-IN OSCILLATORS | | | | | | |
| RESISTORS | | | | | | |
| R101,109 | 100 ohm | Carbon Comp | 2W, 5% | Speer | RC42GF101J | 804-101-05 |
| R102 | 22K | Carbon Comp | ½W, 5% | Speer | RC20GF223J | 802-223-05 |
| R103,108 | 2.2K | Carbon Comp | ½W, 5% | Speer | RC20GF222J | 802-222-05 |
| R104,112,113 | 10K | Carbon Comp | ½W, 5% | Speer | RC20GF103J | 802-103-05 |
| R105 | 1.8K | Carbon Comp | ½W, 5% | Speer | RC20GF182J | 802-182-05 |
| R106,107 | 3.3K | Carbon Comp | ½W, 5% | Speer | RC20GF332J | 802-332-05 |
| R110 | 470 ohm | Carbon Comp | ½W, 5% | Speer | RC20GF471J | 802-471-05 |
| R111 | 6.8K | Carbon Comp | ½W, 5% | Speer | RC20GF682J | 802-682-05 |
| R114 | 0-10K Var | Wire Wound | ¼W | Spectrol | 84-3-8-103 | 819-103-84 |
| R122,123,124, 127,128,129 | SEE TABLE | | | | | |
| R125 | FSV | Carbon Comp | ½W, 5% | Speer | RC20GF__J | FSV |
| R126,131 | 10K | Metal Film | 1/8W, 1% | Dale | RN60C1002F | 813-100-2F |
| CAPACITORS | | | | | | |
| C101,102 | 100 uf | Alum Elect | 25V | Sprague | 500D107G025DD7 | 824-107-51 |
| C103,104,105,106 | SEE TABLE | | | | | |
| C109,110 | FSV | Dip Mica | 500V | Elmenco | DM15__J | FSV |
| DIODES | | | | | | |
| CR101 | | Glass Diode | | Sylvania | 1N457A | 844-457-XX |
| CR102 | | Surmetic Zener | | Motorola | MZ500-11 | 843-500-XX |
| TRANSISTORS | | | | | | |
| Q101,105 | | Silicon | | RCA | 40250-V1 | 839-402-5V |
| Q102 | | Silicon | | Fairchild | 2N4356 | 834-435-6X |
| Q103,104,106 | | Silicon | | Fairchild | 2N3568 | 835-356-8X |
| Q107,108 | | Silicon | | Fairchild | 2N4249 | 832-424-9X |

| SCHEMATIC DESIGNATION | VALUE | DESCRIPTION OR TYPE | RATING | MANUFACTURER | | ELGAR PART NUMBER |
|---|---|---|---|---|---|---|
| | | | | NAME | PART NUMBER | |
| INTEGRATED CIRCUITS | | | | | | |
| Z101,102 | SEE TABLE 6-1 | | | | | |
| ADDITIONAL PARTS FOR TWO-PHASE OSCILLATORS | | | | | | |
| RESISTORS | | | | | | |
| R115 | 475 ohm | Metal Film | ¼W, 1% | Dale | RN60C4750F | 813-475-0F |
| R136 | 0-10K Var | Wire Wound | ¼W | Spectral | 84-3-8-103 | 819-103-84 |
| R137,139 | 10K | Metal Film | 1/8W, 1% | Dale | RN60C1002F | 813-100-2F |
| R138 | SEE TABLE 6-1 | | | | | |
| CAPACITORS | | | | | | |
| C108 | SEE TABLE 6-1 | | | | | |
| INTEGRATED CIRCUITS | | | | | | |
| Z103,105 | | Op Amp | | Amelco | 741CE | 849-174-1X |
| ADDITIONAL PARTS FOR THREE-PHASE OSCILLATORS | | | | | | |
| RESISTORS | | | | | | |
| R132,135 | 10K | Metal Film | 1/8W, 1% | Dale | RN60C1002F | 813-100-2F |
| R133 | 0-10K Var | Wire Wound | ¼W | Spectral | 84-3-8-103 | 819-103-84 |
| R134 | SEE TABLE 6-1 | | | | | |
| CAPACITORS | | | | | | |
| C107 | SEE TABLE 6-1 | | | | | |
| INTEGRATED CIRCUITS | | | | | | |
| Z104 | | Op Amp | | Amelco | 741CE | 849-174-1X |

| SCHEMATIC DESIGNATION | VALUE | DESCRIPTION OR TYPE | RATING | MANUFACTURER | | ELGAR PART NUMBER |
|---|---|---|---|---|---|---|
| | | | | NAME | PART NUMBER | |
| PARTS PECULIAR TO 0.1% OSCILLATORS | | | | | | |
| RESISTORS | | | | | | |
| R116 | 2.2K | Carbon Comp | ½W, 5% | Speer | RC20GF222J | 802-222-05 |
| R118 | 1K | Carbon Comp | ½W, 5% | Speer | RC20GF102J | 802-102-05 |
| DIODES | | | | | | |
| CR103 | | Zener | | I.R. | 1N821 | 843-821-XX |
| INTEGRATED CIRCUITS | | | | | | |
| Z106 | | Voltage Comparator | | National | LM311 | 849-LM3-11 |
| PARTS PECULIAR TO 0.01% OSCILLATORS | | | | | | |
| RESISTORS | | | | | | |
| R116 | 33K | Carbon Comp | ½W, 5% | Speer | RC20GF333J | 802-333-05 |
| R117 | 3.3K | Carbon Comp | ½W, 5% | Speer | RC20GF332J | 802-332-05 |
| R118 | 10K | Carbon Comp | ½W, 5% | Speer | RC20GF103J | 802-103-05 |
| R119 | 470 ohm | Carbon Comp | ½W, 5% | Speer | RC20GF471J | 802-471-05 |
| R120 | 2.2K | Carbon Comp | ½W, 5% | Speer | RC20GF222J | 802-222-05 |
| R121 | 1K | Carbon Comp | ½W, 5% | Speer | RC20GF102J | 802-102-05 |
| CAPACITORS | | | | | | |
| C112 | .01 uf | Ceramic Disc | 50V, 10% | Centralab | DD103 | 821-103-00 |
| INDUCTORS | | | | | | |
| L1 | 150 uh | | | Nytronics | SWD150 | 851-150-01 |
| X101 | 153.6 KHz | Crystal | | Valpe-Fisher | | 864-153-R6 |
| INTEGRATED CIRCUITS – SEE TABLE 3-1 | | | | | | |
| PARTS PECULIAR TO 0.0001% OSCILLATORS | | | | | | |
| X101 | | 153.6 KHz | | Monitor | 153-6 KHz | 864-153-C0 |

SECTION VI

TABLE 6-1

| FREQUENCY | R122 R127 | R123 R128 | R124 R129 | C103 C105 | C104 C106 | C107 C108 | R138 | Z101 Z102 |
|---|---|---|---|---|---|---|---|---|
| 50 | 19.6K | 9.53K | 6.34K | 2 uf | .082 uf | .33 uf | 11.5K | 741 |
| 60 | 17.4K | 9.76K | 4.32K | 2 uf | .082 uf | .33 uf | 8.06K | 741 |
| 400 | 14.3K | 7.15K | 4.75K | .33 uf | .012 uf | .047 uf | 8.06K | 741 |
| 800 | 15K | 7.87K | 5.11K | .15 uf | .0068 uf | .022 uf | 11.5K | 741 |
| 1200 | 15.8K | 5.36K | 4.75K | .1 uf | .004 uf | .015 uf | 8.06K | 741 |
| 3200 | 6.04K | 3.01K | 2.00K | .1 uf | .0039 uf | .0047 uf | 11.5K | LM301 |
| 4800 | 4.02K | 2.00K | 1.33K | .1 uf | .0039 uf | .0047 uf | 8.06K | LM301 |
| 10 KHz | 23.2K | 11.5K | 7.68K | .0082 uf | 330 pf | .001 uf | 11.5K | LM301 |

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